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THESIS

**A DOLLAR COST EVALUATION OF
MAINLAND CHINA'S MAJOR WEAPON SYSTEMS**

by

Wang, Chih-Hsiang

December 1994

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A DOLLAR COST EVALUATION OF MAINLAND CHINA'S MAJOR WEAPON SYSTEMS

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Submitted in partial fulfillment
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ABSTRACT

Military analysts have consistently had difficulties determining the size of defense activities of the People's Republic of China. It is believed that mainland China's official reports on its military expenditures are understated. There is, however, another defense indicator, called the military capital stock, that measures the total assets in inventory. These assets include military equipment (such as tanks and planes), military facilities (such as headquarters and supply depots), and the war reserve spares, ordnance, and other stocks that are held in inventory. As estimates for China's defense budget are so unreliable, adapting the capital stock method holds the potential for increasing one's understanding of the size of China's military activities.

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I. INTRODUCTION

Military analysts have consistently had difficulties determining the size of defense activities of the People's Republic of China (PRC). In 1991, the Central Intelligence Agency estimated the Chinese defense budget to be $12 billion (in 1990 dollars), however, the U.S. Arms Control and Disarmament Agency (ACDA) estimated a figure of $51 billion for the same year. In 1990, ACDA estimated that the cost of China's 1989 defense activities was $24 billion. In 1994, the ACDA changed their 1989 estimate to $49 billion. Rand corporation analysts placed the spending estimate for 1990 at $63 billion, while a recent Foreign Affairs article estimated the Chinese defense outlay at $90 billion.[1]The World Military Expenditures Project of the Stockholm International Peace Research Institute (SIPRI) stated in 1992 that actual Chinese defense spending was anywhere from "two to four times higher" than official figures, and ended up with a range from $12 billion $25 billion.[2]

It is thus difficult to devise a satisfactory formula for estimating China's defense expenditures that can be used for comparison with similar expenditures of other countries.[3] By simply converting the official 1993 figures as provided by the People's Republic (from renminbi to dollars), the resulting figures are as shown in Fig. 1:

Figure 1 would make it appear as if China's defense budget is much less than that of the U.S. and most Western European countries. It appears to be slightly higher than that of India, while less than that of Japan, South Korea and Taiwan.

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1 Gregory G. Hildebrandt, *The Size and the Burden of Defense Activities; China and the Soviet Union,*(unpublished), 1993.

2 *SIPRI Yearbook 1993, PP.387.*

3 *Asia-Pacific Defense Reporter April-May 1994, pp.13.*

As the PRC possesses the third largest number of military aircraft,[4] an army in excess of three million personnel, and at least twenty-six successfully orbited satellites, Fig. 1 may present a misleading picture of the size of mainland China's defense activities.

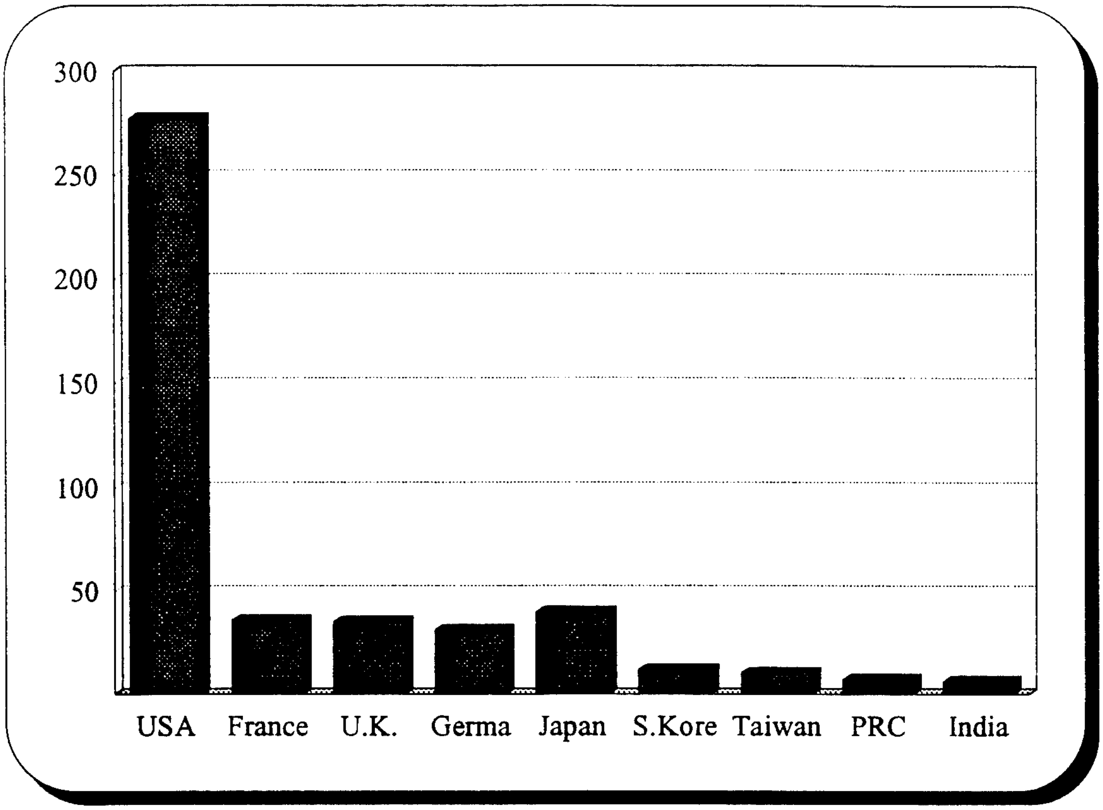

Figure 1. Selected Defense Budget (Billion of 1993 US$)

Source: The Military Balance 1993-1994

There is, however, another defense indicator that measures the total assets in inventory called the military capital stock. These assets include military equipment (such as tanks and planes), military facilities (such as headquarters and supply depots), and the war reserve spares, ordnance, and other stocks that are held in inventory.[5] As estimates

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4 *Asia-Pacific Defense Reporter April-May 1994, pp.14.*

5 Gregory G. Hildebrandt, *Services and Wealth Measures of Military Capital (Measures of Military Capital)*, Defense Economics, 1990, Vol. 1, pp.159-176.

for China's defense budget are so unreliable, adapting the capital stocks method holds the potential for improving one's understanding of the size of China's military activities. This thesis uses The Technique for Assessing Comparative Force Modernization (TASCFORM), developed to assess U.S. weapons performance, to measure the performance levels obtained by the weaponry of the various services of China's military.[6] In addition to providing an indicator of weapon performance, there is also a systematic relationship between the weapons scores and dollar cost of U.S. weapons. Therefore, the TASCFORM methodology can be used to estimate the dollar cost of the weapon systems of Chinese military.

To understand the capabilities of the Chinese military, it is helpful to understand how the People's Liberation Army's (PLA) command and management structure operates. Therefore, this thesis will first discuss the command and management of the PLA in Chapter II. Chapter III analyzes the PLA's ground forces. By using the TASCFORM relationship between performance and cost, the dollar cost of major weapons systems is estimated. Major weapons, such as tanks, armored personnel carriers, artillery, and helicopters are in the ground forces category. Chapter IV also uses TASCFORM technique to explore the performance scores and cost of the PLA's aircraft. In the air force category, bombers, fighters, and helicopters are analyzed. Chapter V analyzes the PLA's naval forces. Since TASCFORM does not provide a relationship between its performance scores and cost for naval vessels, a cost estimating relationship (CER) is employed. China started its space program in the late 1950's. Chapter VI, then, will discuss the development of Chinese space activities. Finally, Chapter VII presents the author's conclusions.

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6 TASCFORM provides static indicators of military force potential called Weapons System Performance (WSP).

II. COMMAND AND MANAGEMENT OF THE PLA

Since leadership in China is highly concentrated at the top, an understanding of their command and management structure is helpful for determining China's overall military capabilities. This chapter will discuss the main command structure of the PLA. The focus of this investigation is structure, defense technology, and interrelationships between departments of the PLA.

A. THE CENTRAL MILITARY COMMISSION

The Central Military Commission (CMC) commands the central role in the Chinese defense establishment. The CMC consists of a chairman, one or two co-chairmen, a chief secretary, one to three co-secretaries and some staff. In 1982, the PRC established the National Military Commission (NMC) to distinguish commands from CMC. However, the NMC is staffed with the same individuals as the CMC; it is believed there's no functional distinction between these two organizations.[7] The CMC supervises three main departments, the Headquarters of General Staff, General Political Department and General Logistics Department. These three officers conduct the day-to-day affairs of the PLA. The CMC also directly commands seven Military Regions, the Navy, the Air Force, the Second Artillery Corps, direct subordinate troops, military academies and National Technology Departments. Army forces are deployed into Provincial Military Area Commands, Sub-Military Area Command, Garrison Commands and Guard Commands. The organization chart of the PLA is shown in Fig. 2.

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7 Paul Humes Folta "The Defense Industry of The People's Republic of China: Command Structure, Industries, Production, And Foreign Trade", Mobilization Concepts Development Center. pp.3.

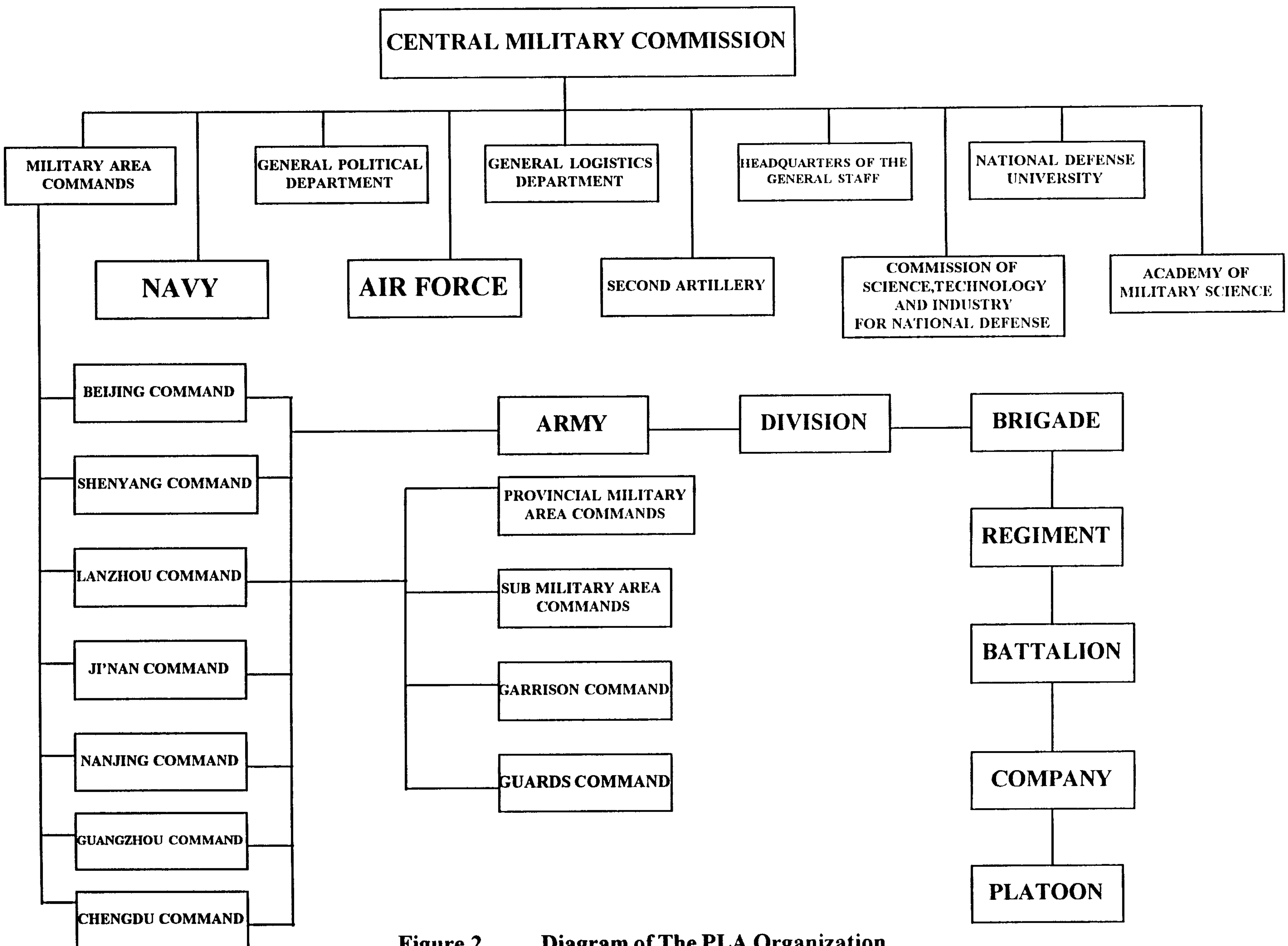

Figure 2. **Diagram of The PLA Organization**

Source: People's Republic of China Year Book,1992/1993

B. THE NATIONAL MILITARY COMMISSION

In 1982, to create an impression of "military nationalization", the People's Republic of China amended its constitution to create a new command system, the National Military Commission (NMC) of the PLA. However the members of the NMC are also members of the CMC. Therefore, there is no functional distinction between these two organizations. However, since the PRC's military reorganization in 1989, some differences have arisen between the two organizations. As to whether the two organizations continue to differ apart will require additional information and analysis.

C. THE MINISTRY OF NATIONAL DEFENSE

The PLA's Ministry of National Defense (MND) once held supreme command over it's military. In the past, with the assistance of the general departments, it managed the military budget, conscription and demobilization, and coordinated defense production with the National Defense Industries Office. Since the establishment of the National Defense Science, Technology & Industry Commission (NDSTIC) in 1982, the MND lost some of its command and policy-making functions. Later, the MND lost most of its remaining power as it was placed in a position below the CMC Secretary General. As a Central Committee member, rather than a Politburo member, the head of the MND lost considerable influence. The present role of the MND is not very clear; however, it seems that the MND is dealing with only reciprocal affairs between CMC and the State Council and holds no practical military command power.

D. THE NATIONAL DEFENSE SCIENCE, TECHNOLOGY & INDUSTRY COMMISSION

The Chinese have made a series of organizational attempts to build a self-sustaining defense industrial base. The National Defense Science, Technology & Industry Commission (NDSTIC) is apparently the product of this attempt. NDSTIC reports directly to the CMC, and possesses the authority equal to a commission of the State Council. Because of its close ties to China's research and development institutes,

and because it maintains a large staff, the NDSTIC plays a key role in the Chinese defense industry.[8]

The NDSTIC also controls important technical programs such as the civilian and military nuclear program, and the space program. Reports reveal that the NDSTIC is also in charge of the import and export of defense products.[9]

E. GENERAL STAFF DEPARTMENT

The General Staff Department (GSD) is primarily in charge of the training, mobilization, communications, operations, intelligence, armament, acquisition of equipment, and mapping and survey. The GSD Central Headquarters controls the service arms headquarters and the service sector headquarters. The service arms headquarters include the PLA-Navy Headquarters and the PLA-Air Force headquarters. The Second Artillery in charge of ballistic missiles, is likely to be under the GSD's administration. Since GSD controls a large number of staff, and partially because of its many responsibilities[10], the GSD possesses a high degree of influence among the three departments.

F. GENERAL LOGISTICS DEPARTMENT

The General Logistics Department (GLD) has responsibility for weapons and ammunition supplies, maintenance, transport facilities and the military medical services. Separate air force and naval logistics organizations are also under the supervision of the GLD. Evidence has revealed that the PLA's military-run businesses are getting larger in recent years. One of the military-run businesses, named "China Hsin-Hsin Corporation",[11] is a consolidation trust that runs various commercial activities in the

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8 Paul Humes Folta "The Defense Industry of The People's Republic of China: Command Structure, Industries, Production, And Foreign Trade", Mobilization Concepts Development Center,pp.17-19.

9 People's Daily revealed in 1992, One of the military-run businesses called "Hsau-Fen Corporation" which belongs to NDSTIC mainly undertakes the imports and exports of the military hi-techs.

10 The same as 10,pp.86.

engineering and technical development fields, is owned by the GLD. In addition to military necessities, factories supervised by the GLD also produce non-military products such as clothing and household goods.

G. GENERAL POLITICAL DEPARTMENT

The General Political Department (GPD) can be considered a bureau that is designed to secure centralized control over the military. However, the GPD deals mainly with ideological affairs, financial inspections, and supervision of the PLA's operational and technical training. It also conducts sports, culture, and entertainment for the armed forces.[12] The key person in the system is the political commissar. He links together the functions of the political departments and the party committees and is responsible for the relationship and interaction between the military and civil society. Political commissars seem to be coequal in rank and responsibility with the military commander.[13] Although debates on democracy have increasingly arisen in the military, the GPD still holds a special status in the PLA.

H. ARMED FORCES

Despite the fact that PLA troops are expected to obey orders coming from the top, military leaders possess key roles on many strategic decisions. It is for this reason that the leaders of the PRC are always simultaneously in charge of the CMC and hold command authority over the troops.[14]

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11 According to the People's Daily revealed in 1992, China Hsin-Hsin corporation had made a pre-taxed profits of 1.5 billion Yuan and its total imports and exports was 2.66 billion Yuan in 1991. This corporation is still absorbing foreign investments and has more than 17 joint businesses up to now.

12 Paul H. B. Godwin, "Development of The Chinese Armed Forces", The Political-Military Affairs Division Airpower Research Institute, pp.40.

13 Paul H. B. Godwin "The Chinese Communist Armed Forces", The Political-Military Affairs Division Airpower Research Institute,1988.

14 In June 1994, Jiang,Zemin, the president of PRC and the head of the CMC, promoted 19 officers to full generals which was believed to establish his leadership over military.

The PLA is divided into seven Military Regions, seven Military Air Regions and three Fleet Commands.[15] Based on territorial boundaries, the Military Regions are divided into Beijing Command, Shenyang Command, Lanzhou Command, Ji'nan Command, Nanjing Command, Guangzhou Command, and Chengdu Command as shown on Fig. 3. The Military Air Regions are also deployed on the same base of territorial boundaries as Military Regions; its headquarters is located in Beijing.[16] Naval forces are deployed into three fleet commands; East Sea Fleet Command, South Sea Fleet Command and North Sea Fleet Command. Later chapters will further discuss the PLA's force structure and the capital value of its major weapons.

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15 Same as 15, pp.45.

16 The Military Balance, 1993-1994.

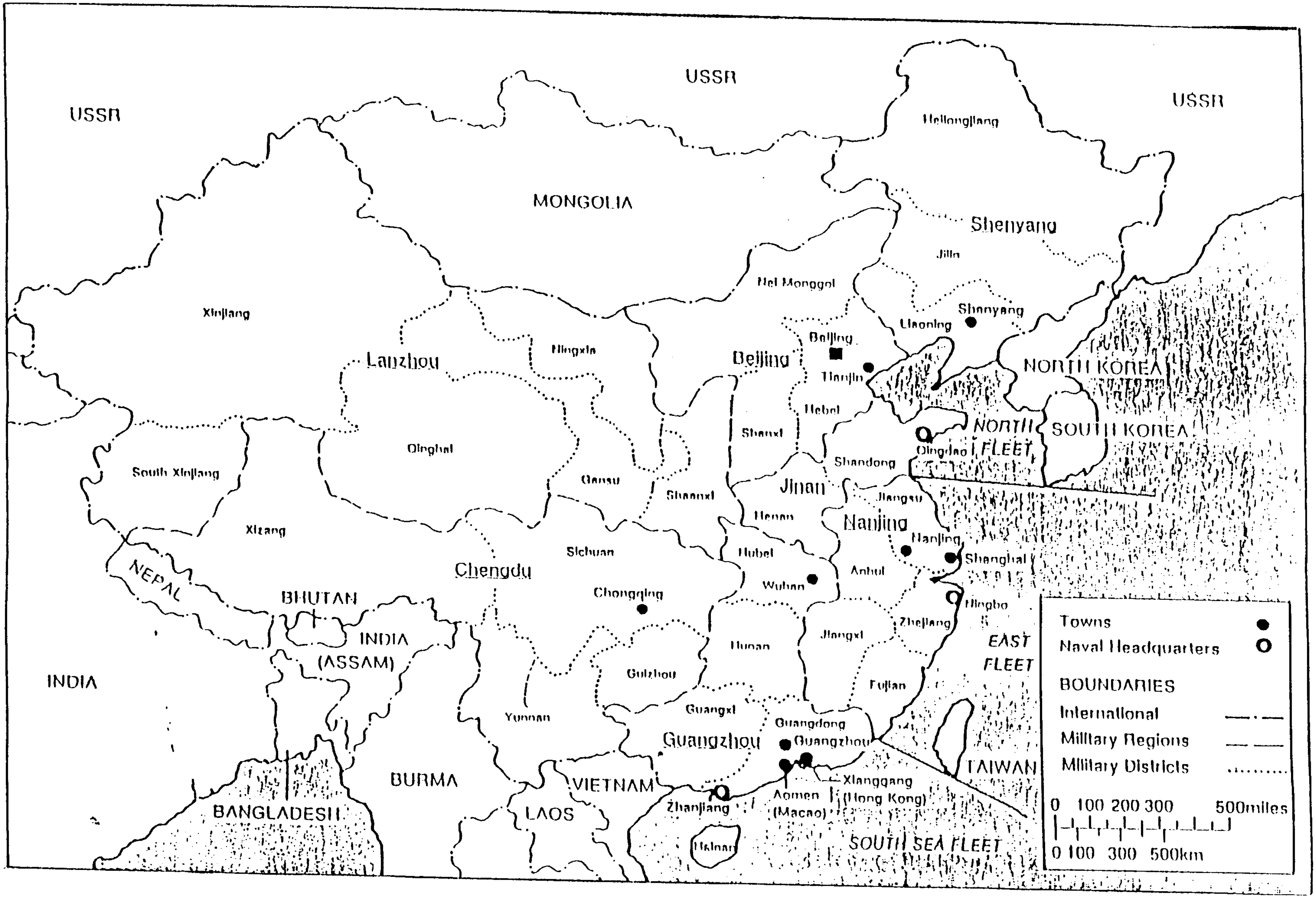

Figure 3. Chinese Military Region

Source : The Military Balance 1993-94

III. GROUND FORCES

The Chinese People Liberation Army (PLA) possesses about 2.3 million personnel deployed in seven Military Regions. The PLA has a total of 93 infantry divisions, 10 armored divisions, and 68 local divisions. Table 1 shows a summarized subordinates and deployment of each Military Region.

MILITARY REGION	POSITION	SUBORDINATES
SHENYANG	NORTHEAST CHINA	Including Helongjiang, Jiling and Liaoning Military Districts. Possesses three armored divisions, 18 infantry divisions and 17 local divisions including two to three divisions of border defense units.
BEIJING	NORTH CHINA	Hebei and Shandong Military Districts. Possesses five armored divisions, 28 infantry divisions and 12 local divisions.
LANZHOU	NORTHWEST CHINA	Gansu, Ningxia, Qinghai and Shanxi Military Districts. Possesses six infantry divisions and eight local divisions, including two to three divisions of border defense units.
CHENGDU	SOUTHWEST CHINA	Sichuan and the Tibet, Guizhou, and Yunnan Military Districts. Possesses 15 infantry divisions and 11 local divisions, including two to three divisions of border defense forces.
GUANGZHOU	SOUTH CHINA	Gungdong, Guangxi, Hainandao, and Hunan Military Districts. Possesses 12 infantry divisions and 11 local divisions, including two to three divisions of border defense forces.
JINAN	EAST CHINA	Shandong Military District. Possesses one armored division, eight infantry divisions, and three local divisions.
NANJING	EAST CHINA	Anhui, Jiangsu, and Zhejiang Military Districts. Possesses one armored division, six infantry divisions and six local divisions.

Table 1. Force Deployment of The PLA Army

Source: Foreign Broadcast Information Service, JPRS Report 5 May 1994.

The PLA's major weapons include 9,500 tanks, 14,500 artillery pieces and field guns, tactical ground to ground missiles, and combat helicopters. A summary of the total number of weapons held in these categories is listed in Table 2.

	Item	Number
MBT:		
	Type-59	6,000
	T-69(MOD Type-59)	800
	T-34/85	700
LIGHT TANK:		
	Type-63 AMPH	1,200
	Type-62	800
APC:	Type-53 and others	2,800
TOWED ARTY :		
	130mm: Type-591-95	1,000
	155mm: WAC-81	30
	152mm: Type-54/66/83	1,400
	122mm: Type-54/60/83(d-30)	6,000
	100mm Type 59/86	6,070
AIR DEFENSE ARTILLERY:		15,000

Table 2. PLA's Major Ground Weapons

Source: IISS Military Balance 1993-94

A. ARMORED WEAPON SYSTEMS

The Analytic Science Corporation (TASC) concluded that the cost of the U.S. main battle tank is roughly proportional to performance.[17] The measure of performance, the Weapon System Potential (WSP) of each system, is evaluated by calculating the basic performance characteristics, including: (1) main gun and/or missile payload, (2) weapon range, (3) system maneuverability, and (4) system mobility.[18] The linear graph of the relationship between unit costs (in constant fiscal year 1981 dollars) for all armor and artillery system is shown in Fig. 4. The estimated cost and performance of China's

[17] TASC report, "Assessing U.S. weapon system modernization cost and performance trends", 29 April 1985.
[18] See TASC pp.6-2.

armored weapon systems (main battle tanks, light tanks and armored personnel carrier) is Table 3 as follows:

(In 1993 thousand $)

	Item	Weapon System Potential	Number	Unit Cost	Capital Value
MBT					
	Type-59	5.863	6,000	827.75	4,966,500
	T-69(MOD T-59)	5.948	800	850.325	680,260
	T-34/85	10.082	700	1,444.8	1,011,360
Light Tank					
	Type-63 AMPH	6.103	1,200	872.9	1,047,480
	Type-62	4.787	800	617.05	493,640
APC	Type-531 and others	2.135	2,800	316.05	884,940
Total					9,084,180

Table 3. Tanks

The above data reveals the capital value of China's armor weapons (MBT , light tanks and APC) is approximately $9.08 billion in 1993 dollars.(a purchase deflator of 1.556 is applied, refer to Table 17).

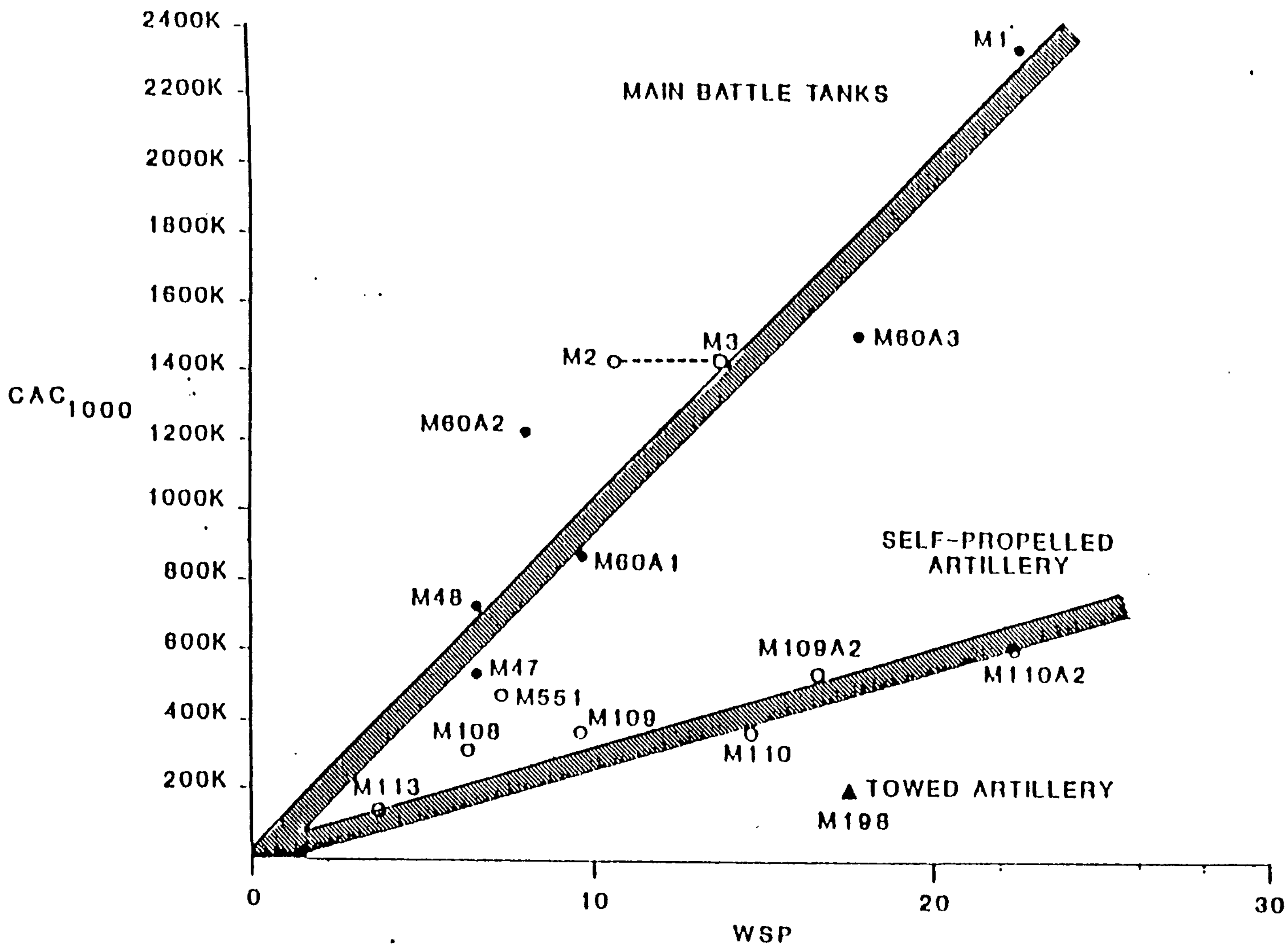

Figure 4. **Cost vs. WSP forArmor and Artillery**

Source : TASC Report 29 April, 1985

B. ARTILLERY WEAPONS

TASC measures artillery WSP by its (1) payload weight, (2) weapon range, and (3) system mobility.[19] The cost and performance of China's artillery weapons (towed artillery and ADA) are as follows:

(In 1993 thousand dollars)

	Item	Weapon System Performance	Number	Unit Cost	Capital Value
Towed ARTY					
	100mm	8.4965	6,070	376.25	2,283,837.5
	122mm	9.3583	6,000	391.3	2,347,800
	130mm	10.906	1,000	451.5	451,500
	152mm	10.344	1,400	436.45	611,030
	155mm	19.613	30	842.8	25,284
AD ART	35/57/85/100mm	6.627	15,000	285.95	4,289,250
Total					10,008,701.5

Table 4. Artillery

To estimate the cost, the relationship for U.S. self-propelled artillery of Fig. 4 is employed. Note that the single observation for U.S. towed artillery indicates that a lower cost may be applicable. Therefore, the estimated artillery cost of Table 4 may be somewhat overstated.

The data indicates that the capital value of China's artillery weapons is approximately $10.01 billion (1993 dollars).

[19] See TASC pp.5-2.

IV. AIR FORCE

The PLA Air Force possesses about 470,000 personnel deployed in seven Military Air Regions. They have approximately 470 bombers, 4,000 fighters, 485 transport planes, 290 reconnaissance planes and about 1,100 helicopters. A summary of the PLA's major air force weapon systems as Table 5.

Table 5. PLA's Major Air Force Weapons

	Item	Number
Bomber:		
	Medium H-6	150
	Light H-5	480
FGA:	Q-5	600
Fighter:		
	J-5	440
	J-6/B/D/E	3,500
	J-7	550
	J-8	110
	SU-27	20
	SU-27/B	4
RECCE:		
	HZ-5	40
	JZ-5	150
	JZ-6 AC	100
Transport:		
	BAE	18
	I1-14	30
	I1-18	10
	I1-76	10
	LI-2	50
	Y-5	300
	Y-7	25
	Y-8	25
	Y-11	15

	Y-12	2
Helicopters:	AS-322	6
	Bell 214	4
	MI-17	28
	S-70C-8	44
	MI-8	30
	Z-5	290
	Z-6	100
	Z-8	15
	Z-9	90
	SA-348	8

Source: IISS Military Balance 1993-94 (including Army Air and Navy Air)

A. COST AND PERFORMANCE SCORES

The Analytic Science Corporation (TASC) generates weapon system potential (WSP) by its basic system measurement of effectiveness reflecting (1) payload, (2) aircraft range, basing modes, and standoff weapon range, (3) maneuverability, and (4) speed. Figure 5 shows cost vs. performance of U.S. aircraft (attack, fighter, bomber, and patrol aircraft) on the same trend line[20]. Reconnaissance and transport planes are not included in this cost to performance relationship. Therefore, their costs are not calculated. The cost and performance of China's air force (bomber, FGA, fighter, and helicopters) are shown in Tables 6, 7, and 8 respectively.

[20] The slope of the trend line is 0.76. See TASC report 'Assessing U.S. Weapon System Modernization Cost And Performance Trends' 29 April, 1989 for detail.

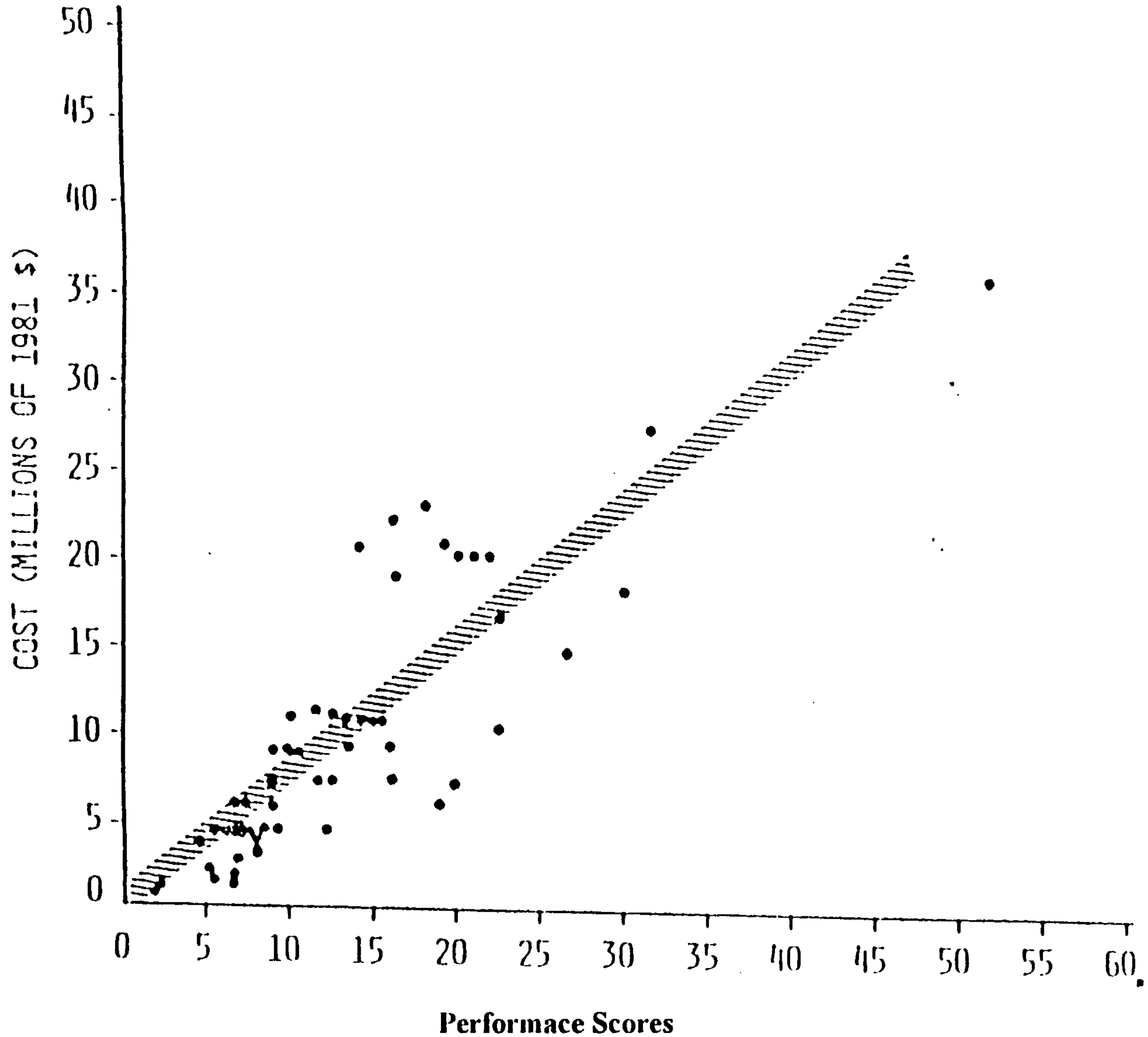

Figure 5. **Cost vs. Performance-U.S. Aircraft**

Source : TASC Report

B. BOMBERS

The PLA possesses two types of bombers: medium H-6 and light H-5. The H-6 medium type bomber shows higher performance scores than the light H-5. The total capital value of bomber weapon systems is calculated as approximately $5.18 billion in 1993 dollars (a purchase deflator of 1.533 is applied, refer to Table 18). The cost and performance scores are as follows:

(In 1993 million dollars)

	Item	Weapon System Performance	Number	Cost	Capital Value
Bombers					
	Medium: H-6	9.565	150	11.82	1,773
	Light: H-5	5.5	480	7.092	3,401.16
Total					5,177.16

Table 6. Bombers

C. FIGHTERS

In the PLA's fighter wing category, J-type aircraft still dominates the inventory numbers. Due to age, performance of these J-type aircraft are relatively low. The acquisition of SU-27 fighters had increased total performance scores; however, the numbers of these more modern aircraft are still limited. The cost and performance scores are shown as follows:

(In 1993 million dollars)

Item	Model	Weapon System Performance	Number	Unit Cost	Capital value
FGA	Q-5	5.180	600	7.6436	4,586.16
Fighters					
	J-5	4.311	440	6.304	2,773.76
	J6/B/D/E	6.063	3,500	8.671	30,348.5
	J-7	3.862	550	5.516	3,033.8
	J-8	5.679	110	8.195	901.45
	SU-27	17.321	20	22.064	441.28
	SU-27B	17.321	4	22.064	88.256
Total					42,173.206

Table 7. Fighters

The total capital value of the fighters is approximately $42.2 billion (1993 dollars).

D. HELICOPTERS

Helicopters reveal low performance scores in the aircraft category. There are ten types of helicopters in the PLA's aircraft inventory. A total capital value is approximately $785 million (1993 dollars) The cost and performance scores are summarized as follows:

(In 1993 million dollars)

Model	Weapon System Performance	Number	Unit Cost	Capital value
AS-332	1.21	6	1.396	8.378
BELL-214	1.23	4	1.399	5.598
MI-17	1.14	28	1.308	36.624
S-70C-8	1.15	44	1.311	57.684
MI-8	1.15	30	1.311	39.33
Z-5	0.98	290	1.259	365.11
Z-6	1.01	100	1.277	127.7
Z-8	1.22	15	1.398	20.97
Z-9	1.13	90	1.30	117
SA-348	0.719	8	0.8	6.4
Total				784.794

Table 8. Helicopters

V. NAVAL FORCES

The PLA Navy possesses about 260,000 personnel (including 25,000 in aviation, 25,000 in coastal defense units and 5,000 naval infantry) deployed into three fleet commands: East Sea Fleet Command, South Sea Fleet Command and North Sea Fleet Command. They have one nuclear-fueled ballistic-missile submarine (SSBN), forty-six tactical submarines of various types, fifty-six principle surface combatants, some 1,500 coastal combatants, one hundred and eight-five mine sweepers (mine countermeasure vessels), four hundred and twenty-one amphibious landing craft, approximately one thousand naval aircraft, and other miscellaneous support and systems. A summary of the PLA's naval weapon systems is shown in Table 9.

Table 9. Naval Forces

Type	Nomenclature	Number
Submarine:		
Strategic SUB: SSBN		1
Tactical SUB:		
	SSN: HAN with 533mm TT	5
	SSG: modified ROMEO	1
	SS: type ES5E	6
	ES3B	33
	SLBM(trials):	1
Principle Surface Combatants:		
Destroyer: DDG		18
Frigate: FFG		33
FF		5
Patrol and Coastal Combatants:		
Missile Craft:		215
Torpedo Craft		160
Patrol Craft:		495
Coastal Craft:		100
Inshore:		350
Riverine:		45
Mine Warfare:		126

Minelayer:	1
MCM: SOV T-43 MSO	35
WOSAO MSC	5
Lienyun AUX MSC	80
Fushun MSI	5
Drone MSI	60
Amphibious Craft:	
Yukan LST	3
Shan(US LST-1)	13
Yuliang	30
Yuling	1
Yudao LSM	4
Craft: LCU	320
LCP	40
LCT	10
Support:	
Fuging AO	2
AOT	33
AF	4
SUB SPT	10
SUB Rescue	1
Repair	2
Qiong Sha TPS TPT	9
TPT	30
Survey/Research/Experimental	33
Icebreaker	4
Ocean Tugs	25
TRG	1
Miscellaneous: LT TPT AC	60

Source: IISS Military Balance 1993-94

In the previous chapters, we applied the TASCFORM technique in analyzing the relationship between cost and performance scores of the PLA's ground and air forces. However, for naval forces, the cost estimating relationships employed by the U.S. Department of Defense (DOD) is preferable. DOD has used Cost Estimating Relationships

(CER) depicting the association between cost and full-load displacement of each major category of U.S. ship[21]. This CER technique first determines the full-load of each type of ship and then applies a specific formula to obtain an estimated cost. In this chapter, therefore, I will use the CER method to estimate the cost of the PLA's major naval weapon systems (Submarines and Surface Combatants).[22] Not all categories of naval vessels will be examined using this method; small craft, amphibious landing craft, and support vessels are not included in this study.

A. SUBMARINES

CER calculates cost of U.S. submarines by the following formulae:

(1). For SSBN, $C = 392e^{0.078D}$

(2). For SS and SSG, $C = 46 + 45.3D$

(3). For SSN, $C = 206 + 45.3D$

where C = estimated cost in millions of 1983 dollars and D = submerged displacement in thousands of tons.

The 1983 dollar figure was deflated to 1993 dollars using the Navy's Total Obligational Authority (TOA) Purchases Deflators[23] (1.42). Using the formulae described above, Table 10 shows the numbers and capital value of the PLA's submarines. The total cost of the PLA's submarines is $10.7 billion (1993 dollars).

[21] The results of the analysis are reported in the FY 1986 Department of Defense Program for Research Development and Acquisition, Statement by the Under Secretary of Defense, Research and Engineering, to the 99th Congress First Session, 1985,pp.v-6. DoD employs CERs discuss in an Institute for Defense Analysis study, Cost Estimating Relationships for U.S. Navy Ships, by William J.E. Shafer.

[22] Naval Aircraft are analyzed as part of the air forces of the PLA, and are included in the previous chapter.

[23] U.S. Weapon Systems Costs, 1994. Ted Nicholas and Rita Rossi, Fourteenth Edition, Data Search Associates, refer to Table 19 for navy deflator.

(In millions of FY 1993 U.S. dollars)

Type	Full Load Displacement	Number	Cost per Ship	Capital Value
Strategic SUB: SSBN	8,000	1	1,039.79	1,039.79
Tactical SUB:				
SSN: HAN	5,000	5	614.15	3,070.75
SSG: modified ROMEO	1,650	1	171.46	171.46
SS: type ES5E	1,475	6	160.20	961.20
ES3B	1,475	33	160.20	5,286.60
Soviet Golf:	2,350	1	216.49	216.49
Total		47		10,746.29

Table 10. Numbers and Capital Value of PLA's Submarines

Source: The Military Balance 1993-94 pp. 123 and Jane's Fighting Ships 1993/1994 pp. 115 -138

B. PRINCIPAL SURFACE COMBATANTS

CER calculates cost of U.S. surface combatants by the following formula:

(1). For class DDG and FFG, $C = 86.1 + 41.2D$

(2). For class FF, $C = 11.1 + 37.8D$

where C = estimated cost in millions of 1983 dollars and D = ship full load displacement in thousands of tons.

Like submarines, the 1983 dollar figure of ships was deflated to 1993 dollars by the same factor (1.42). Table 11 shows the numbers and capital value of the PLA's major surface combatants is as shown in Table 11.

Type	Full Load Displacement	Number	Cost Per Ship (in millions of 1993 dollars)	Capital Value (in millions of 1993 dollars)
Destroyer: DDG				
Luhu	4,200	1	367.98	367.98
modified Luda	3,670	2	336.97	673.94
Luda	3,670	15	336.97	5,054.55
Frigate: FFG				
Jiangwei	2,250	2	253.90	507.80
Jianghu (Type-I)	1,702	18	221.84	3,993.12
Jianghu (Type-II)	1,820	9	228.74	2,058.66
Jianghu (Type-III. IV)	1,924	5	234.82	1,174.10
Jiangdong	1,924	1	234.82	234.82
Chengdu	1,460	3	207.68	623.04
FF: Jiangnan	1,600	5	101.64	508.20
Total		61		15,196.21

Table 11. Numbers and Capital Value of PLA's Principal Surface Combatants

Source: The Military Balance 1993-94 pp. 123 and Jane's Fighting Ships 1993/1994 pp. 115 -138.

The PLA's major surface combatants show a total capital value of $15.2 billion (1993 dollars).

VI. SPACE PROGRAM

A. INTRODUCTION

In 1957, the Soviet Union launched it's first successful artificial orbiting earth satellite, Sputnik 1. Three months later, the U.S. launched it's first satellite (Explorer 1) into orbit. Since then, thousands of satellites have been placed into orbit, and space has become a new battlefield for the superpowers. As the technology to build space-launch vehicles is closely akin to that for long-range ballistic missiles, the U.S. and the former USSR had long been the only two countries that had the capabilities to launch satellites. However, in 1970, China successfully launched its first satellite, the China 1, thus breaking the two-nation monopoly on space research. Among categories of satellites, Earth Observation Satellites are used to obtain photographs of military value, such as detection of nuclear explosions in the atmosphere and in space, ballistic-missile launch sites, and ship and troop movements. Since satellite use has broad military applications, developing space programs can be considered one element of military activities. This chapter will discuss the development of China's space program, which has been distinguished by many achievements since it's inception.

B. HISTORY

China began her space program in the late 1950's. In 1970, China launched its first satellite the China 1. In 1975, China for the first time successfully recovered one of it's satellites from space. In 1987, China began to provide commercial satellites for sale to foreign countries, and hence entered into the launch services market in competition with the US, the former Soviet Union and the European Space Agency. By the end of 1993, China had made at least 26 launches, successfully placed more than 50 satellites into orbit.

C. DEVELOPMENT AND ACTIVITIES

China has developed five series of carrier rockets: the Long March No. 1, Storm No. 1, Long March No. 2 (including model 2c and 2e), Long March No. 3 and Long March No. 4. China's satellite launch sites are at the Jiuquan Satellite Center for oval orbit satellites, the Xichang Satellite Center for geostationary satellites, and the Taiyuan Satellite center for solar stationary satellites. Table 12 shows China's space activities chronologically since 1970.

Table 12. China's Space Launches

Name	Launch Date	Launched By	Launch Site	Weight	Purposes	Life Span	Remarks
China 1	04/24/70	Long March 1	Jiuquan	173 kg	communication	100 years	China's first satellite
China 2	03/03/71	Long March 1	Jiuquan	221 kg	science	3028 days	
China 3	07/26/75	Long March 2	Jiuquan	3500 kg		50 days	
China 4	11/26/75	Long March 2	Jiuquan	3500 kg		33 days	First satellite recovered
China 5	12/16/75	Long March 2	Jiuquan	3500 kg		42 days	
China 6	08/30/76	Long March 2	Jiuquan	270 kg		817 days	
China 7	12/07/76	Long March 2	Jiuquan	3600 kg		1 section recovered after 3 days, 2nd section stayed in space for a further 23 days	
China 8	01/26/78	Long March 2	Jiuquan	3600 kg		12 days	recovered
China 9,10,11	06/19/81	Long March 2	Jiuquan		astrophysics	7, 382, 332 days respectively	Launch rocket with 3 satellites

China 12	09/09/82	Long March 2	Jiuquan	3600 kg	reconnaissance satellite test, remote sensing	5 days	recovered
China 13	08/19/83	Long March 2	Jiuquan	3600 kg	possible operational reconnaissance flight	15 days	recovered
China 14	01/29/84	Long March 3	Xichang	900 kg	experimental communications		
China 15	04/08/84	Long March 3	Xichang	900 kg	communication	1 year	First successful experimental communication satellite
China 16	09/12/84	Long March 1	Jiuquan	3600 kg	presumed to be a reconnaissance mission	17 days	recovered
China 17	10/21/85	Long March 2	Jiuquan		possible survey land resources, environmental protection, mineral exploitation, forestry development	17 days	recovered China could then provide foreign customers with both geostationary and Earth resource launches
China 18	02/01/86	Long March 3	Xichang	900 kg	communication		
China 19	10/06/86	Long March 2	Jiuquan		land surveillance, mineral prospecting, environmental protection, mapping and land use planning	1 section orbited 5 days and then recovered in Gansu, second section orbited 17 days	
China 20	08/05/87	Long March 2	Jiuquan		scientific and technological exploration	10 days	recovered, this was the first commercial launch for French company Matra
China 21	09/09/87		Jiuquan		science		
China 22	09/08/88	Long March 4	Taiyuan		weather experiment		First experimental weather satellite

China 23	04/08/90	Long March 3	Xichang	1250 kg	transmit TV, telephone, communicationS	10 years	
China 24	01/20/91				carry out sounding of the ionosphere, testing development of carrier rockets, projectile guided missiles, artificial satellites, man-carrying space ships		First space sounding carrier rocket
China 25	03/22/92	Long March 2-E	Xichang				failed. China's second commercial launch for Australia
China 26	04/08/94	Long March 1	Xichang		weather satellite		failed

Source: "Space Programmes", "The PRC Year Book 1992/93", "The Administration's Decision to License the Chinese Long March Launch Vehicle- Hearings Committee on Science, Space, and Technology U.S. House of Representatives, Sep. 23 and 27, 1988". and various sources.

D. ISSUES

Because the Chinese are able to provide inexpensive satellite services,[24] it has been an attractive launch option for low cost commercial systems. Questions have also been raised about the manner in which this has gained for the Chinese access to certain types of Western satellite technology. China has responded that its capability to launch rockets is limited. However, due to their low cost, China has undoubtedly gained quite a significant place in the space field. One of their most noticeable events was the successful recovery of it's satellite following their fourth satellite launches on November 26,1975, for the point on China possessed the ability to use satellites to perform military missions.

[24] China Daily Report, June 3,1986 reported "it was 10 to 15 percent less than the international rate of about 30 million dollars per geostationary launch".

It is difficult to determine how many military purpose satellites have been launched by China, Western analysts used to assume that the recoverable satellites - China 4, 7, 8, 12, 13, 16, 17, and 19 - were reconnaissance or spysats. Typically, however, they were later evaluated as "Earth resources" satellites. However, even a research satellite (like land survey and mapping) can contribute to defense activities.

E. CONSTRAINTS

China claimed to increase launch activities from one to three times a year to as many as 10 annually.[25] However, increased rocket development and launch needs are poorly met by their existing launch facilities.[26] China still has a need to construct additional launch pads to meet the expanding need of their missile launch capacity.

China's secretive space program may have allowed them to hide failures records (e.g. unsuccessful launches, malfunctioning satellites). This had made insurers unwilling to insure satellites launched by the Chinese. Hence, foreign firms may hesitate to contract launch activities with China.

China relies heavily upon U.S. satellite technology. Additionally, many satellites that are launched by China are provided by U.S.. In 1988, the Bush Administration made a decision to grant export licenses that allowed for Chinese launching of US-made satellites on a case-by-case basis.[27] As a result, China's satellite program depends, in part, on U.S. support.

F. CONCLUSION

China's attempts at marketing launch vehicle services have met with some success. However, the degree to which China markets for commercial satellites in competition with the United States and Europe depends on several important factors.[28] First, U.S. decisions on whether U.S. satellites can be exported to China could determine the success

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[25] China Daily Report, June 6, 1986.

[26] There is one launch pad at Xichang, second one had likely been built.

[27] "The Administration's Decision To License The Chinese Long March Launch Vehicle", Hearing before the Committee on Science, Space, And Technology U.S. House of representatives on hundredth congress, second session, September 23 and 27, 1988 no.145. pp.382.

[28] Same as 27, adapted from pp.414-415.

or failure of the Chinese effort. Another factor is the degree to which China is willing to invest in expanding launch vehicle production rates and providing additional ground supports. China tries to make profits from commercial satellites, which is a way of obtaining funds for developing their space program.

VII. CONCLUSION

This thesis discussed the PLA's (1) command structure, (2) major weapon systems, and (3) space activities. A determination of the capital value for the major equipment of each arm of the Chinese military is depicted in Fig. 6.

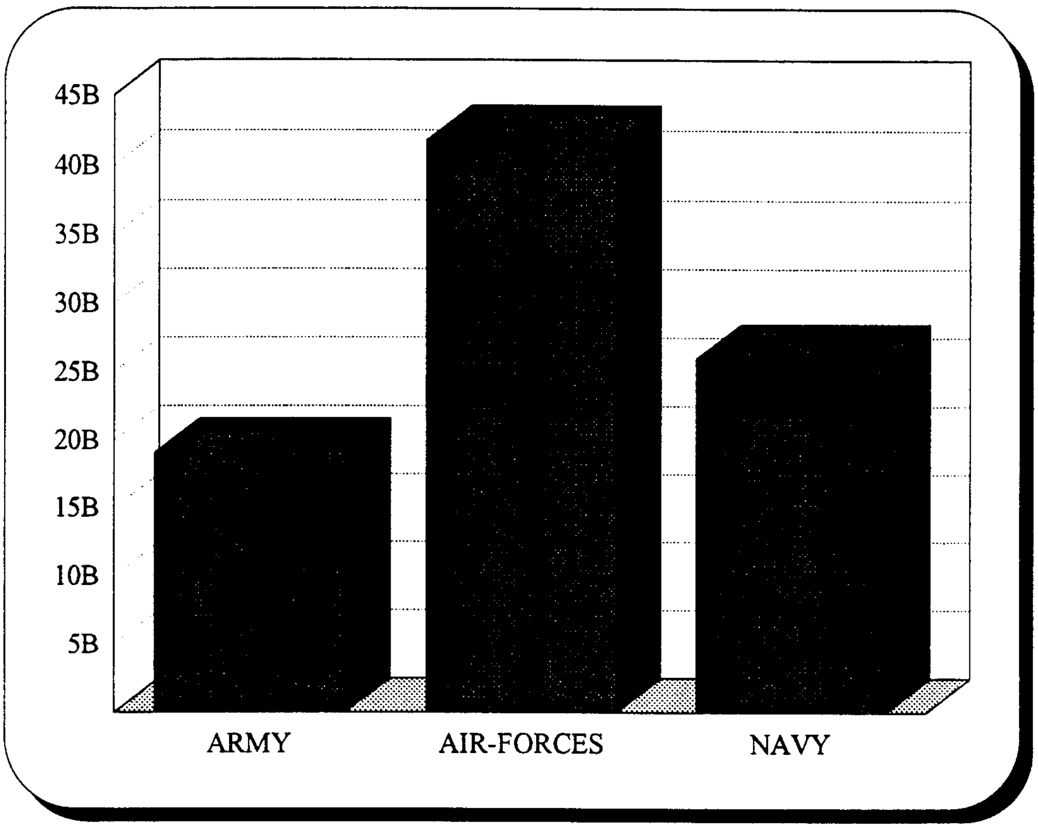

Figure 6. Capital Value of China's Military Services Major Equipment

The capital value of the ground forces (including main battle tanks, light tanks, APCs, towed artillery, and air defense artillery) is calculated $19 billion (1993 dollars). The capital value of air force (including bombers, FGA, fighters, and helicopters) is approximately $42 billion (1993 dollars). The capital value of naval forces (including submarines and principal surface combatants) is approximately $26 billion (1993 dollars).

AREAS FOR FURTHER RESEARCH

This thesis applied the TASCFORM technique to analyze the cost of China's major army and air force weapon systems. For naval forces, cost estimating relationships (CERs) are employed. Consistency, however, might be lost. If TASCFORM could extend its analysis of the relationship between cost and the WSP for naval forces, it would be worthwhile to refine the capital value of the naval component of the PLA.

Some weapons are not examined, such as reconnaissance and transport planes in the air force category, patrol and coastal combatants in the naval category, miscellaneous equipment like trucks and guns and strategic missile forces. Cost estimating relations might be employed to estimate the dollar cost of these equipment types.

This study concentrates on the capital value of the PLA's order of battle. However, it is also important to understand the level of operating and support costs associated with the equipment. The dollar size of the operating and support activities would provide an indicator of the readiness of the PRC's military.

China's space development and activities are discussed in this study. Additional research would help one better understand which satellites support military activities and what the dollar cost of these military space activities equals.

Appendix A

THE TASCFORM-ARMOR MODEL

METHODOLOGICAL OVERVIEW

The TASCFORM-ARMOR model is a technique that allows for measurement of the effectiveness for armored vehicles (tank), armored personnel carriers (infantry fighting vehicles) and other close combat systems. Combat vehicles with heavy weapon systems (20mm or larger and armored personnel carriers with heavy machine guns) are considered by this model.

Baseline System

The baseline system selected for the TASCFORM-ARMOR model is the M-60A1 main battle tank. This selection was made based on:

1. Wide deployment throughout the 1965 to 2005 time period.
2. First major variant of an important series.
3. Near state-of art at time of introduction.

Measures of Effectiveness

The Weapon Potential (WP) measures of effectiveness reflecting:

-- Main gun and/or missile payload

-- Weapon range(s)

--System maneuverability

--System mobility

The WP formula in TASCFORM-ARMOR is:

$$WP = (F_{PL} \times (PL_{gun} + PL_{msl})) + \left[F_{WR} \times \left(\frac{PL_{gun}}{(PL_{gun}+PL_{msl})} \times WR_{gun} + \frac{PL_{msl}}{(PL_{gun}+PL_{msl})} \times WR_{msl} \right) \right]$$
$$+(F_M \times M) + (F_{SM} \times SM)$$

where

PL_{gun} = Number of rounds carried for tank and antitank guns, recoilless rifles, and unguided rocket launchers divided by 63 rounds, the M-60A1 baseline

value. For light automatic cannons ($\leq 30mm$), the number of rounds carried is divided by 100 before normalizing to account for burst firing

PL_{msl} = Number of missiles carried divided by 63 rounds, the baseline value

WR_{gun} = Maximum effective gun/unguided rocket range (i.e., where Ph = 0.50 for best round) in km divided by 1.8 km, the M-60A1 value

WR_{ms} = Maximum missile range in km:1.8 km

M = System battlefield maneuverability, expressed in KW/tonne divided by 14.9 kw/tonne, the baseline value. (For manpack systems, an average well-conditioned adult male is assumed capable of 3.0 kw/tonne output).

SM = System mobility, the best road speed in kph divided by 48 kph, the M-60A1 value. (For manpack systems, that same adult male is assumed capable of 6.0 kph on a sustained basis).

F_{XX} = Weighting factors for system characteristics, where

$$\sum_{XX=1}^{4} F_{XX} = 10$$

XX = Basic system characteristics, ie., payload (PL), weapon range (WR) system maneuverability (M), and system mobility (SM).

TASCFORM-ARMOR is unique in its factoring of platform maneuverability into its calculations for ground combat systems. Mobility is also considered an important part of the calculation for indirect fire artillery and air defense artillery (ADA) systems, as their ability to accompany their support forces is a crucial factor in their employment.

The values of systems characteristic weighting factors (F_{XX}) are shown in Table 13. Scenario sensitivity is considered a critical factor in the validation of the model. While the nominal values are calculated with an eye toward high intensity conventional warfare on the plains of Central Europe, weights are considered for cases involving desert warfare (a Mideast scenario) and restricted range cases.

Table 13 Potential Characteristic Weighting Factor (F_{XX}) Value

Weighting Factor	Nominal Case	Mideast Case	Restricted Range Case
Fpl	3	2	3
Fwr	3	4	2
Fm	2	2	3
Fsm	2	2	2

Appendix B
THE TASCFORM-ARTILLERY MODEL

METHODOLOGICAL OVERVIEW

The TASCFORM-ARTILLERY model measures the effectiveness of conventional indirect fire artillery systems. The weapon systems considered include artillery (field gun and tube artillery cannon), high trajectory fire motars, multiple rocket launcher systems (MRLs). Systems may be employed by either land-based Army or Marine forces, or as part of the on-board arsenals of Naval forces. Targets could ostensibly be engaged either at land or sea.

Measures of Effectiveness

The Weapon Potential (WP) measures of effectiveness reflecting:

-- Payload weight

-- Weapon range

--System mobility

Artillery Roles

TASCFORM-ARTILLERY differentiated between land and sea based systems in the following manner:

1. Land-based systems are designated as self-propelled (SP) tube systems, towed or fixed tube systems, or MRL systems.
2. Sea-based systems are tube or MRL only.

   Artillery System Considered the full set of major ground forces and naval tube and MRL systems of 20mm bore diameter and greater.

Baseline system

The value of Fxx, as in all other TASCFORM models, is a subjective determination, based on expert analysis of the systems. The attribute weighting factor

values Fxxr) for land- (tube artillery and MLRs) and sea-based systems used in TASCFORM-ARTILLERY are shown in Table 14.

The Weapon Potential (WPr) measures of effectiveness for artillery systems is formulated::

$$WP_r = (F_{PL_r} \times PL) + (F_{WR} \times WR) + (F_{SM_r} \times SM)$$

where

r = Artillery role

PL = Payload, the weight of a round in kg, divided by 43 kg (the M-109 baseline value for ground systems) or 32 kg (the MK 42 baseline value for sea systems). In the case of MRL, PL is determined by multiplying the weight of the rocket warhead by the number of ready rounds before normalizing to the baseline. This reflects the greater instantaneous fire power of MRL systems relative to tube systems.

WR = Maximum weapon range using full charge or rocket assist, in km, divided by 14.6 km (the baseline value for ground systems) or 23.4 km (the baseline value for sea systems).

SM = System mobility, expressed as best road speed in kph divided by 56 kph, the baseline. For towed or manpack systems, this speed is the best possible for the weapon/prime mover combination. For naval mounts and fixed land systems, SM = 0. For naval mounts, mobility is a function of the hulls upon which they are mounted.

$F_{XX'}$ = Weighting factors for system characteristics in role r, where

$$\sum_{XX=1}^{3} F_{XXr} = 10$$

XX = Basic weapon characteristics, i.e., payload (PL), weapon range (WR), land system maneuverability (SM).

As in the other TASCFORM models, F_{XXr} values are determined subjectively. The values have been reviewed by an assemblage of experts. Table 14 shows F_{XXr} values for the TASCFORM-ARTILLERY model.

Table 14 Attribute Weighting Factor (F_{XXr}) values

Weighting Factor	Land Based Tube Systems	Land Based MRL Systems	Land Based Sea Systems
Fpl	4	5	5
Fwr	4	3	5
Fsm	2	2	0

Appendix C

THE TASCFORM-AIR MODEL

METHODOLOGICAL OVERVIEW

Measures of effectiveness for individual aircraft, as well as tactical air forces groups, are produced by TASCFORM-AIR. Only those types of principal combat aircraft designed to deliver conventional munitions against air and surface targets are considered. Reconnaissance, ECM, FAC, and AEW aircraft are not considered. The model assumes the two major roles of considered aircraft to be air combat and surface attack. Table 15 shows the standard missions within each of these two roles.

AIR COMBAT	SURFACE ATTACK	
Fighter Interceptor	Close air support/ battlefield air interdiction (CAS/BAI)	Heavy bomber
	Interdiction	Heavy air-to-surface missile (ASM) launcher
	Attack helicopter	Antiship cruise missile (ASCM) launcher
	Heavy bomber	
	Heavy air-to-surface missile (ASM) launcher	

Table 15. Roles of Air Model

Computing the measure of effectiveness for a single aircraft is a three-step process. First, the airframe, power plant, and payload characteristics are computed to determine a weapon potential score, which is then normalized against the U.S. F4B, the TASCFORM-AIR baseline aircraft. The impact of the various characteristics of the aircraft are weighted subjectively to the contribution made in an air combat or surface attack role. When a new model or modification of an existing aircraft significantly changes that aircraft's capabilities, the updated version is treated as a different aircraft.

Weapons system potential is computed by scoring on-board systems, such as weapons, navigation, and avionics.

The method of computing measures of effectiveness for individual aircraft is summarized as follows:

The Weapon Potential (WP) measures of effectiveness reflecting:

-- Payload

-- Aircraft range, basing modes, and standoff weapon range

--Maneuverability

--Speed

Weapon System Potential (WsPr) Air Combat Roles

The Weapon System Potential is a measure of effectiveness determined by calculating the characteristics of payload, range, basing mode, missile standoff (as a factor in overall engagement range), maneuverability, and speed of the aircraft. These characteristics yield a score which is then normalized against the baseline aircraft, the U.S. F4B. The formula for WSP is expressed as:

$$WP_r = (F_{PLr} \times PL_r) + (F_{Rr} \times (R + BF + 2MR)) + (F_{Mr} \times M_r) + (F_{Vr} \times V_r)$$

where

PL_r = Payload expressed in number of air-to-air ordnance stations, including 1 for an internal gun, divided by 8, the F-4B normalizing value.

R+BF+2MR= Maximum range (R) for a clean aircraft, using internal fuel only to fly a high-low-high mission profile; plus a basing factor (BF) of 200 km for V/STOL capability, 450 km for seaplane or STOL capability, or 750 km for CTOL or V/STOL shipboard basing capability; plus two times missile range for those aircraft capable of launching long-range air-to-air missiles (LRAAM), the sum divided by 1800 km, the F-4B normalizing value. The missile's range is doubled to represent the effective increment to aircraft range rather than to its radius of action

M_r = Maneuverability of the aircraft, represented be excess specific power (P_s). In the fighter role P_s is divided by 122 meters/second, the F-4B normalizing value. In the interceptor role, P_s is divided by 92 m/s, again the appropriate F-4B normalizing value

V_r = Useful airspeed expressed in kph, in the air combat roles, divided by 1390, the F-4B normalizing value

F_{PLr} =Weighting factor for payload

F_{Rr} =Weighting factor for range (plus basing mode and twice missile range as applicable)

F_{Mr} =Weighting factor for maneuverability

F_{Vr} =Weighting factor for useful airspeed

and

$\sum F_{rxx} = 10$ for any role.

In varying roles, performance characteristics have obviously different relative values. For example, aircraft designed to fill a fighter role have different needs than those designed as interceptors (range, maneuverability, etc.). As a result, weighting factors for the four performance characteristics (PLr, R, Mr, and Vr) are necessary. The weighting factor values for aircraft filling air combat roles are shown in Table 16.

Weighting Factor	Fighter	Interceptor
Fplr	3	4
FRr	2	3
FMr	3	1
FVr	2	2

Table 16. Performance Characteristic Weighting Factor Values, Air Combat Roles

The WSPr term is additive rather than multiplicative based on the following logic: an aircraft in which each of the basic performance attributes, PLr, R, Mr, and Vr, are twice

those of a predecessor is considered to be twice as capable, and not 16 times as capable as it would be if the same attributes were considered multiplicative.

APPENDIX D

TASCFORM WEAPON SYSTEM DATABASE

The Technique for Assessing Comparative Force Modernization (TASCFORM) is a series of weapon system assessment models developed to determine the relative performance characteristics of like types of military weapons. The models provide static indicators of military force potential. These measures of effectiveness are based on the characteristics and numbers of individual weapon systems. They are expressed as numerical scores.

Individual weapon systems measures of effectiveness for aircraft, armor, artillery and other systems are determined by comparing payload, range, speed, maneuverability, targeting and guidance. and other characteristics to those of selected baseline weapon systems. The relative importance of these characteristics for each weapon system is calculated through use of a weighting, in which subjective factors were determined by panels of expert using Delphi techniques. These weapons system potential values can be used to determine individual system capability, or in the aggregate to show assumed force potential for an entire fleet or inventory.

TASCFORM, in its ability to determine measures of effectiveness for individual weapon systems (and to take into account such diverse factors as logistics, C3I, and personnel), can be used for a number of purposes. First, it can be used for conducting net assessments of current and future military balances within geographic regions. It can also help strategic and operational planners compare forces. Finally, systems analysis can use the model to study technological development and cost-performance measures.

TASCFORM assesses the military potential of the following types of ground systems for the years 1965 to 2005:

- Air defense systems
  - Terminal air defense systems
  - Regional systems
  - Mobile air defense systems
- Artillery systems
  - Self-propelled tube systems
  - Towed or fixed tube systems

- Multiple rocket launchers

- Armor systems
  - Tanks
  - Armored personnel carriers
  - Command vehicles
  - Infantry fighting vehicles
  - Reconnaissance vehicles
  - Anti-tank weapon systems
- surface to Surface Missiles
  - Ballistic guided missiles
  - Free rockets over ground

TASCFORM assesses the military potential of the following types of air systems for the years 1965 to 2005:

- Air to ground air systems
  - Close air support aircraft
  - Interdiction aircraft
- Air to air systems
  - Fighter aircraft
  - Interceptor aircraft

TASCFORM assesses the military potential of the following types of sea systems, by evaluating the platform separately from the weapon systems and then combining the scores. Weapon systems are assesses by weapon type and mission, for the year 1965 to 2005:

- Non-ASW weapon systems
  - Guns
  - Missiles
  - surface to air missiles
- ASW weapon systems
  - Ship platforms
  - Submarine platforms
  - Aircraft platforms

- Platform systems
  - surface platforms
  - Submarine platforms
  - Aircraft platforms

APPENDIX E

Fiscal Year	R.D.T.&E.	Procurement				
		Aircraft	Missiles	Wep & Veh	Ammo	Other
1973	31.2	27.9	28.4	28.2	32.8	33.6
1974	34.4	30.8	31.0	31.1	35.1	36.8
1975	37.9	33.3	33.4	33.5	38.6	39.8
1976	40.6	35.8	35.9	36.0	41.5	42.8
1977	44.2	39.6	39.8	39.9	45.7	47.3
1978	48.0	43.8	44.1	44.1	49.8	51.6
1979	52.7	48.7	49.1	49.3	54.4	56.2
1980	57.9	54.2	55.1	55.0	58.9	60.4
1981	62.5	59.9	60.6	60.7	62.8	63.7
1982	65.8	64.5	65.2	65.2	66.0	66.3
1983	68.3	68.2	68.4	68.5	68.4	68.5
1984	70.7	70.7	70.7	70.7	70.6	70.7
1985	72.8	72.8	72.8	72.8	72.8	72.9
1986	74.9	75.1	75.0	75.1	75.0	75.2
1987	77.2	77.7	77.8	77.8	77.7	77.9
1988	80.1	80.8	80.9	80.9	80.5	81.0
1989	83.3	83.9	84.1	84.1	83.7	84.0
1990	86.7	86.9	87.0	87.0	86.6	86.9
1991	89.7	89.5	89.5	89.5	89.5	89.4
1992	92.2	91.9	91.9	91.9	92.0	91.9
1993	94.6	94.4	94.4	94.4	94.5	94.4
1994	97.2	97.1	97.1	97.1	97.1	97.1
1995	100.0	100.0	100.0	100.0	100.0	100.0
1996	102.9	102.9	102.9	102.9	102.9	102.9

Table 17. DOD Deflators-Army
Source: U.S. Weapon Systems Costs, 1994

APPENDIX F

Fiscal Year	R.D.T.&E.	Procurement		
		Aircraft	Missiles	Other
1973	31.2	29.0	28.9	31.7
1974	34.2	31.6	31.4	34.5
1975	37.8	34.1	33.8	38.1
1976	40.6	36.8	36.5	41.0
1977	44.2	41.2	40.8	44.8
1978	47.9	45.7	45.3	48.6
1979	52.5	50.9	50.8	53.1
1980	57.7	56.5	56.4	58.0
1981	62.4	61.5	61.6	62.4
1982	65.8	65.6	65.6	65.8
1983	68.3	68.5	68.4	68.3
1984	70.6	70.7	70.6	70.6
1985	72.8	72.9	72.8	72.8
1986	74.9	75.3	75.2	75.0
1987	77.2	78.1	78.1	77.4
1988	80.0	81.2	81.2	80.2
1989	83.3	84.2	84.2	83.4
1990	86.6	86.9	86.9	86.6
1991	89.6	89.4	89.4	89.6
1992	92.2	91.8	91.8	92.1
1993	94.6	94.3	94.3	94.6
1994	97.2	97.1	97.1	97.1
1995	100.0	100.0	100.0	100.0
1996	102.9	102.9	102.9	102.9

Table 18. DOD Deflators-Air Force
Source: U.S. Weapon Systems Costs, 1994

APPENDIX G

Fiscal Year	R.D.T.&E.	Procurement				
		Aircraft	Weapons	Ships	Other	M.C.
1973	31.0	28.2	28.2	30.6	33.9	28.5
1974	34.0	30.8	30.9	33.9	36.9	31.0
1975	37.7	33.4	33.4	37.4	39.9	33.6
1976	40.4	35.9	35.9	41.3	43.0	36.3
1977	44.0	39.9	39.9	46.9	47.6	40.4
1978	47.7	44.0	44.1	51.7	52.0	44.7
1979	52.3	49.0	49.1	56.2	56.5	49.9
1980	57.5	54.6	54.8	60.3	60.6	55.3
1981	62.3	60.1	60.3	63.7	63.8	60.5
1982	65.7	64.7	64.9	66.4	66.3	64.8
1983	68.2	68.2	68.3	68.6	68.5	68.1
1984	70.6	70.0	70.7	70.9	70.7	70.7
1985	72.8	72.8	72.8	73.4	72.8	72.8
1986	74.9	75.1	75.1	76.0	75.2	75.2
1987	77.2	77.8	77.8	78.7	78.0	78.0
1988	80.0	80.8	80.9	81.5	81.1	81.0
1989	83.2	84.0	84.0	84.1	84.1	84.0
1990	86.6	86.9	86.9	86.7	86.9	86.8
1991	89.7	89.5	89.5	89.2	89.4	89.4
1992	92.2	91.9	91.9	91.7	91.8	91.9
1993	94.6	94.4	94.4	94.3	94.4	94.4
1994	97.2	97.1	97.1	97.1	97.1	97.1
1995	100.0	100.0	100.0	100.0	100.0	100.0
1996	102.9	102.9	102.9	102.9	102.9	102.9

Table 19. DOD Deflators-Navy
Source: U.S. Weapon Systems Costs, 1994

APPENDIX H

GLOSSARY

ACDA	ARMS CONTROL AND DISARMAMENT AGENCY
ADA	AIR DEFENSE ARTILLERY
AF	STORES SHIP WITH RAS CAPABILITY
AOT	TANKER WITHOUT RAS CAPABILITY
APC	ARMORED PERSONNEL CARRIER
ASW	ANTI-SUBMARINE WARFARE
BBR	BOMBER
CER	COST ESTIMATING RELATIONSHIP
CMC	CENTRAL MILITARY COMMISSION
DDG	DESTROYER WITH AREA SAM
DOD	DEPARTMENT OF DEFENSE
FGA	FIGHTER, GROUND-ATTACK
FF	FRIGATE
FFG	FRIGATE WITH AREA SAM
GSD	GENERAL STAFF DEPARTMENT
GLD	GENERAL LOGISTICS DEPARTMENT
GPD	GENERAL POLITICAL DEPARTMENT
LT	LIGHT TANK
MND	MINISTRY OF NATIONAL DEFENSE
MBT	MAIN BATTLE TANK
MCM	MINE COUNTERMEASURES
MR	MARITIME RECONNAISSANCE/MOTOR RIFLE
NMC	NATIONAL MILITARY COMMISSION

NDSTIC	NATIONAL DEFENSE SCIENCE, TECHNOLOGY & INDUSTRY COMMISSION
PLA	PEOPLE'S LIBERATION ARMY
RECCE	RECONNAISSANCE
RAS	REPLENISHMENT AT SEA
SAM	SURFACE-TO-AIR MISSILE
SPT	SUPPORT
SSBN	NUCLEAR-FUELED BALLISTIC-MISSILE SUBMARINE
SSN	NUCLEAR-FUELED SUBMARINE
SSGN	SSN WITH DEDICATED NON-BALLISTIC MISSILE LAUNCHERS
SS	SUBMARINE
SLBM	SUBMARINE-LAUNCHED BALLISTIC MISSILE
TASC	THE ANALYTIC SCIENCE CORPORATION
TASCFORM	TECHNOLOGY FOR ASSESSING COMPARATIVE FORCE
TPT	TRANSPORT
TRG	TRAINING
WSP	WEAPON SYSTEM POTENTIAL

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